ANSWERS: Practical Procedures

1. Increases the rate of reaction;
(Condensing) prevents volatile chemicals from being lost to the environment,
(The mixture refluxed to increase reaction rate without loss of product through evaporation).

2. Gas = Carbon dioxide / CO_2
$NaHCO_3$ *is* used to remove any remaining acid *mixed with the liquid product.*
Na_2SO_4 is added to remove any remaining water *mixed with the liquid product.*
Fractional Distillation.

Equipment 1.
The purpose of the process is to **purify** the chemical / **remove impurities** / **separate product**
• This is achieved by separating liquids according to their **boiling points**.
• Chemicals are boiled then condensed / liquid-gas then gas-liquid.
The fraction at the desired boiling point is kept / other fractions are discarded.

3. Aldehyde (Butanal) is obtained by distillation of butan-1-ol with acidified (potassium) dichromate / (acidified potassium) permanganate solution.
(Distillation) is used because the aldehyde has a lower boiling point (than butan-1-ol and the carboxylic acid formed) / to prevent it from being oxidised further.
(Both) reactions are oxidation–reduction because butan-1-ol has lost electrons/lost hydrogen/gained oxygen/oxidation number (of C) has increased.
Carboxylic acid (butanoic acid) is obtained by reacting a mixture of butan-1-ol with acidified potassium dichromate solution (under reflux conditions) until all of the reactant has been converted to butanoic acid.
Observations: orange $Cr_2O_7^{2-}$ to green /, purple MnO_4^- to colourless / aldehyde condensed in the condenser.

4. i) D
ii) Refluxing allows the solution to be heated, which increases the rate of the chemical reaction. The reflux apparatus prevents the loss of volatile organic reactants or products.

5. i) The acid is providing the Cl group for substitution with the OH, (indicates a source).
The $NaHCO_3$ solution neutralises any remaining HCl.
The anhydrous sodium sulfate absorbs any water left in the sample (is a drying agent).

ii) The separating funnel allows two reactants to be shaken together and for compounds to be separated based on their solubility or polarity. The haloalkane is not soluble in water and will not mix with the aqueous acid layer. The more dense liquid (aqueous or acid) will be in the lower level, and can be run off by removing the stopper and opening the tap.

Distillation purifies the sample. It separates the sample from liquid impurities with different boiling point. The haloalkane has a different boiling point to any other substances remaining. It will have the lower boiling point. The liquid at the lower boiling point will start to boil at a lower temperature. It will evaporate and move down the condenser, where it is cooled and returned to the liquid state.

6. (Methanoic acid + 2-methylpropan-1-ol □ 2-methylpropylmethanoate + water)
$HCOOH + HOCH_2CH(CH_3)_2 \rightleftharpoons HCOOCH_2CH(CH_3)_2 + H_2O$

Sulfuric acid is added as a catalyst and/or a dehydrating agent to push the equilibrium reaction towards the product ester by removing the water molecule.
Potassium carbonate is added after completing the reaction to neutralise the excess acid.
Refluxing is used to heat an organic reaction without losing volatile organic reactants or products.
Distillation is used to separate the product from any remaining reactants. It works because all the organic molecules will have different boiling points.

7. a) i) The two clear, colourless solutions would become cloudy on mixing and would then separate out into two layers.
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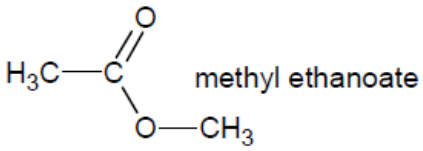
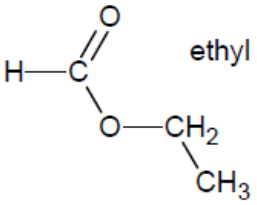
2-chloro-2-methylpropane OR 2-chloromethyl propane
b) i) Aqueous sodium carbonate is added to neutralise any remaining acid. The anhydrous magnesium sulfate is added to dry the organic product (haloalkane).
ii) The alkyl halide is insoluble in water and forms a separate layer, which may be removed using the separating funnel (apparatus C).
Once the acid has been neutralised, the lower aqueous layer once again needs to be removed using the separating funnel (C).
The haloalkane is then placed in the flask and purified by distilling (apparatus D) and only collecting the liquid distilling off close to the BP of the haloalkane.

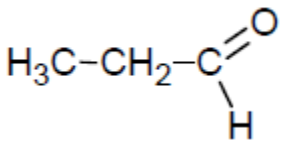


methyl ethanoate



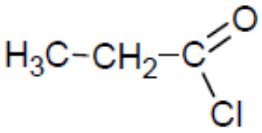
ethyl methanoate

8. a)
b) Possible oxidising agent acidified potassium dichromate / or potassium permanganate / chromic acid.
Diagram (ii) shows a condenser attached on top of the flask to be heated. As water passes through the condensor jacket it cools any vapour which is then returned to the solution. In this way the rate of reaction is increased by heating and none of the organic material is lost through evaporation.



propanal

c) i)
ii) The mixture should not be refluxed, but as the oxidising agent is added to the alcohol and acid catalyst it should be heated and the aldehyde distilled off as it forms.



d) i) propanoyl chloride
ii) Anhydrous means in the absence of water ie dry conditions; water will influence the yield as it will produce the reverse reaction – turning the acid chloride into the carboxylic acid / hydrolysing the PCl_5.
e) i) E = propanamide
ii) G = ammonia /NH_3
f) Ammonia NH_3
Sodium propanoate CH_3CH_2COONa (or the propanoate ion) /Propanoic acid